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ABSTRACT

This paper discusses minicomputer-based ILSs (integrated learning systems), i.e., computer-based systems of hardware and software. An example of a minicomputer-based system in a school district (a composite of several actual districts) considers hardware, staffing, scheduling, reactions, problems, and training for a subskill-oriented reading program for compensatory education students. Specific ILS software packages are then described: (1) the PLATO/WICAT System 300 for primary reading, reading comprehension, writing, language arts (with language arts skills, spelling, and sentence combining components), English as a Second Language, and other academic subjects; (2) the Computer Curriculum Corporation's MICROHOST system for mathematics, reading, language arts, and computer literacy from grade 1 through adult; (3) Houghton Mifflin's Dolphin Curriculum, which is designed to supplement teacher-directed instruction with computer-assisted instruction in reading and language arts skills; and (4) DEGEM Systems' TOAM Computer Aided Instruction System for mathematics and multiple choice drill instruction. The appendix lists publisher, former names, systems software, instructional components, and hardware configurations for each system. (8 references) (MES)

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RECENT TRENDS IN MINICOMPUTER-BASED INTEGRATED LEARNING SYSTEMS FOR READING AND LANGUAGE ARTS INSTRUCTION

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RECENT TRENDS IN MINICOMPUTER-BASED INTEGRATED LEARNING SYSTEMS FOR READING AND LANGUAGE ARTS INSTRUCTION

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An integrated learning system is a computer-based instructional system of hardware and software. It differs from the typical classroom microcomputer primarily in that its component workstations are terminals connected to a central computer or memory storage device. Instructional software is supplied by the publisher. Integrated learning systems offer some important advantages over microcomputers, though there are serious disadvantages as well. ILS's are called by a variety of different labels, such as professional learning systems.

ILS instructional software is typically traditional Computer-Assisted Instruction (CAI), a combination of tutorial presentations and drill and practice exercises. Most of the software is targeted to the teaching of basic skills such as mathematics and reading, and it includes a comprehensive management system for tracking student progress. In recent years, some vendors have recognized the increased interest in using computers as tools and have developed word processing and database software for their systems.

The systems are usually designed to provide students with some specified amount of time each day for practicing the targeted basic skill, perhaps 15 minutes or so. Many school systems find ILS's particularly appropriate for supplying underachieving students with additional drill and practice work (Reinhold, 1986). ILS software has typically been developed specifically for the ILS system and is not available commercially for use on ordinary classroom microcomputers.

The present paper deals with minicomputer-based ILS's. These usually follow in the path of traditional CAI in using a minicomputer as a central device to which so-called "dumb" terminals are connected as student workstations. Minicomputers have much greater memory capabilities than microcomputers. They can deal with many students at one time. A dumb terminal has little memory storage of its own. Unlike the situation with microcomputers, the program remains in the central minicomputer. The terminal simply presents a monitor display derived from the software program in the central minicomputer and allows students to input information to the minicomputer by way of a keyboard.

Minicomputer-Based Systems

The computing power of the minicomputer is far greater than a standard microcomputer, allowing for increased flexibility, complexity of programming, and extensive management and recordkeeping. The minicomputer is typically connected to a hard disk storage device that allows it to access a wide variety of programs instantly and to store large amounts of student records.

The operating system allows "multi-tasking"--that is, different students can have access to different parts of the software at the same time. Some students might be working on letter recognition, others on comprehension development, and still others on arithmetic drills. All are working at their own workstations, that in turn are simultaneously accessing the central minicomputer.

Some systems, such as Computer Curriculum Corporation and PLATO have recently begun to use self-functioning microcomputers as terminals. These workstations are ordinarily directly connected to the minicomputer, but they can be disconnected for independently operated software on diskettes.

Different systems have differing capabilities in terms of number of terminals acceptable, ranging from 5 to over 100. When evaluating systems, schools that foresee the possibility of someday approaching the maximum number of terminals acceptable should carefully check response speed under those conditions. Overloading a minicomputer system with too many workstations will result in dramatically slower responses to student input from the computer.

Many of the systems include utility software in addition to the instructional programs. Most have an authoring program that allows teachers and schools to construct their own CAI software. The WICAT System 300 series, for instance, also has administrative software, a spreadsheet calculator, and a word processor.

An Example of A Minicomputer-Based System in the Schools

The Ridge School District (a composite of several actual districts) has developed a highly subskill-oriented reading program for its compensatory education students. All students are administered a series of locally developed paper and pencil criterion-referenced tests. Each school's reading specialist uses the test results to assign subskill tutorials and practice exercises to be completed during morning reading periods. All compensatory students receive 30 minutes of reading lab instruction per day, in addition to their regular classroom reading period.

Each school's reading laboratory is equipped with about five Apple II-series microcomputers and five terminals that access an ILS minicomputer. Two aides provide for most of the supervision and instruction on the basis of the specialist's assignments. The reading specialist's duties are primarily consultative, as she must also supervise classroom teachers in their implementation of the school's developmental reading program.

Children in the reading lab are typically assigned two to three 15-minute sessions using the microcomputers each week. In addition, they complete three 15-minute ILS lessons per week. Each CBI session is geared toward development of a specific skill identified as a weakness by the district's criterion-referenced testing.

The Ridge district's response to the use of CBI is enthusiastic. Reading scores have "noticeably improved." The

paper and pencil testing, though cumbersome and time-consuming, is viewed as a crucial component of the reading program. The ILS lesson pretests are used, as well. If a child passes the ILS pretest, he or she does not need to complete the related skill lesson.

Despite the overall positive reaction, teachers do have some complaints, many of which identify characteristic problems with ILS's. Only one lesson is available per skill. If a child fails the lesson posttest, he or she is simply recycled back into the same lesson. Ridge teachers typically move such students on to workbook or microcomputer drills on the same subskill rather than subjecting them to another run through a lesson that had failed to teach them the first time.

In addition, student attention span is limited due to the unvarying format of the ILS lessons. The district reports have had at one time assigned students to 30-minute Dolphin sessions. Students were unable to maintain attention for that length of time, however. The teachers report that educational microcomputer games are most motivational. The ILS comes in second, and workbook-based exercises third.

A minimum of teacher training is necessary to use the ILS, less than is required for use of the microcomputers. Supervision responsibilities appear to be minimal, as well. Children seem well able to function independently.

The district office reports that classroom teachers can consult the ILS management system for feedback on student progress. Few or no teachers take time to do this, however. The

reading specialist serves as the direct source of diagnostic information to the classroom teachers.

WICAT System 300

The WICAT System 300 is a minicomputer-based ILS, accepting up to 30 student workstations. The system has audio capability that is particularly useful with beginning readers, and it can use Apple II-series or IBM-PC microcomputers as workstations. These allow students to work with both the System 300 software and standard diskette-based programs. Schools can also choose to use WICAT's own workstation equipment that features touch-sensitive screens. System 300 includes software for primary reading, reading comprehension, writing, language arts (with language arts skills, spelling, and sentence combining components), English as a Second Language, and other academic subjects.

The Primary Reading curriculum is based on 13 types of activities (see Figure 1). These 13 types of activities are used to form 1010 activities in 285 lessons. 40 lessons are at the kindergarten level, 75 at the first grade, 90 at the second grade, and 80 at the third grade. Each activity takes several minutes to complete, and consists of a short tutorial followed by a practice exercise.

The Reading Comprehension curriculum is composed of 565 lessons, each of which is presented as a newspaper article or story. For each lesson, students work on one of four types of activities. In one activity, a portion of the story is displayed

and students are presented a question about it. In another activity, students must remove irrelevant sentences from a passage. The third type of activity involves interpretation of graphs, tables, or maps. The final type of activity involves an evaluation of an editorial, in which students must answer questions as to the author's point of view and evaluate the acceptability of the arguments used in the editorial.

Douglas and Bryant (1985) reported on use of the system in a Texas school system. Teachers and students seemed pleased with results of the lessons, that averaged 20 minutes per day. Reading gains of 9% in the third grade and 6% in the fifth grade were reported, but these statistics were not based on comparison with a control group, so they are of dubious validity.

Computer Curriculum Corporation

Patrick Suppes, director of the pioneering Stanford University CAI project in mathematics (see Chapter 5 of Balajthy, 1988--"An Overview of Research on Computers in Reading"), founded Computer Curriculum Corporation (CCC) in 1967. The corporation's MICROHOST system, based on the Stanford software, is the most financially successful system on the market today (Bork, 1985). While other companies may dispute this assertion, there is no doubt but that CCC brings a wealth of experience to computer-based instruction.

MICROHOST is based on a central minicomputer using the well-known UNIX operating system for increased flexibility. Atari ST

microcomputers serve as student workstations. Each has built-in disk drives for using diskette-based software independently of the MICROHOST system. MICROHOST can also use the IBM-PC and Apple II-series as workstations, but software is limited for these models. MICROHOST provides a Speech System for voice synthesis of some lessons. Up to 128 workstations can be run on the system, though the system speed slows considerably if that number are being used at the same time.

The MICROHOST curriculum includes mathematics, reading, language arts, and computer literacy, from grade 1 through adult. Figure 2 illustrates the teacher report function. The Gains Report indicates the reading comprehension gain over the student's prior twenty sessions, as well as the total gain for the academic year and the student's present grade equivalent standing. The Gains Report indicates exact measures, up to one-hundredth of a grade level, though these distinctions cannot be accepted as valid. Reading performance cannot be measured so accurately.

Computer Curriculum Corporation's Audio Reading component is designed for grades 1 and 2. The system provides two years of daily 12-minute sessions on letter identification, phonics, sight words, meaning vocabulary, and sentence and passage comprehension. A digitized voice synthesizer gives instructions, poses problems, and offers feedback. In the phonics lessons, for example, the synthesizer reads a word or word part on the monitor screen and asks students to repeat it. The students then type a letter or word to fit the pattern.

Houghton Mifflin Dolphin Curriculum

Houghton Mifflin's Dolphin Curriculum is designed to supplement teacher-directed instruction with computer-assisted instruction in hundreds of reading and language arts skills. The system operates on the Digital Equipment Corporation's (DEC) PDP-11 minicomputers.

The Dolphin Reading component is designed to provide daily fifteen minute lessons for children in grades 3 to 8. The entire component consists of 354 lessons, including word attack, comprehension, vocabulary, and study skills (See Figure 3).

Each lesson follows the same basic format: Pretest, practice, posttest, and referral. Five multiple choice items are presented to students in the pretest. If four of the five are answered correctly, the students are moved on to the next skill. If students do not meet the criterion score, they receive a short tutorial and some practice exercises. The practice exercises are concluded with a short summary of the principles learned.

Students then take a posttest, following the same format as the pretest. If they pass, they move on to the next skill. If not, they are referred elsewhere for help. Teachers can design their own referral messages to appear on the monitor screen. For example, if a child fails a posttest on finding main ideas, a teacher might command the following message to appear:

Please complete Problems 1--10 in the Understanding Main Ideas booklet, Mark.

The Dolphin Curricula have been used since the late 1970's.

The United States Office of Education included this system in its National Diffusion Network of exemplary educational projects, and the system has been reviewed positively (Dudley, 1983). Houghton Mifflin has also evaluated the system extensively (Palmer, 1979; Lindsay and Rogers, 1982; Harris, Sandacca, and Hunter, 1985) with generally favorable results.

TOAM Computer Aided Instruction System

DEGEM Systems' TOAM Computer Aided Instruction System was developed by Israel's Center for Educational Technology for mathematics and multiple choice drill instruction. As a result, the system's designers planned for use of a twenty-key terminal, excluding all alphabetic characters. Newer software oriented to language use requires addition of a full keyboard to the student workstation.

TOAM lessons are designed for twenty minute periods. As students achieve satisfactory levels of proficiency, they are moved on to higher level lessons. If they do not show progress, they are kept at the same level or moved to an easier level.

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Figure 1. Activities in the WICAT Primary Reading Curriculum.

1. Letter matching discrimination
2. Picture story sequencing
3. Letter identification
4. Consonant sounds
5. Sight word identification
6. Sound patterns I
7. Sight word practice in context
8. Sentence comprehension
9. Paragraph comprehension
10. Sound Patterns II
11. Word identification through context
12. Multiple word meanings
13. Word meanings through context

Figure 2. MICROHOST (Computer Curriculum Corporation) Student Reports.

Gains Report	Gain Last Period (20 sessions)	Time Last Period	Total Gain (% Grade Year)	Total Time (hrs.)	Course Average (grade level)
Tony Garcia	.20	3:21	.36	4:52	4.76

Figure 3. Houghton Mifflin Dolphin Curriculum Grade 6 Vocabulary and Comprehension Skill List.

Skill Code	Number of Practice Questions	Skill
631	10	Unknown Words (words in context)
632	12	Synonyms/Antonyms
633	15	Homonyms
634	12	Multi-Meaning Words
635	12	Oral Emphasis (context strategies)
636	12	Verb Tense
637	11	Pronoun Referents
638	10	Visualizing
639	12	Details
640	7	Main Idea
641	12	Tone
642	8	Draw Conclusions
643	12	Figurative Language
644	10	Necessary Sequence (Cause/Effect)
645	12	Sequence (Setting/Events)
646	10	Compare/Contrast
647	8	Predict Outcomes
649	12	Fact/Opinion
650	12	Authors, Qualifications
651	12	Authors, Biases
652	10	Authors, Motives

APPENDIX

MINICOMPUTER-BASED INTEGRATED LEARNING SYSTEMS

Computer Curriculum Corporation

MICROHOST System

Publisher:

Computer Curriculum Corporation

1070 Arastradero Road

PO Box 10080

Palo Alto, CA 94303-0812

(415) 494-8450

Former Names:

Systems Software:

Word processing, electronic mail, BASIC, COBOL, Pascal

Instructional Components:

Reading:

Grades 1--8 (Audio Reading, Reading, Basic Reading, Reading for Comprehension, Practical Reading Skills, Dial-A-Drill Reading, Dial-A-Drill Practical Reading)

Grades 7--Adult (Critical Reading Skills)

Grades 9--Adult (Survival Skills)

Adult (Adult Reading Skills)

Adult (GED Preparatory Program)

Language Arts:

Grades 3--6 (Language Arts Strands)

Grades 4--Adult (English as a Second Language)

Grades 2--8 (Dial-A-Drill Spelling)

Grades 6--9 (Writing Skills)

Adult (Adult Language Skills)

Other:

Mathematics: Grades 1--Adult

Computer Literacy: Grades 4--Adult

Programming: BASIC, COBOL, Pascal

Hardware

Central operation: Minicomputer, with UNIX operating system.

Workstations: Atari ST microcomputers, that can function independently using diskette-based software.

Other: Voice synthesis (with student headphones), modem

PLATO/WICAT

System 300

Publisher:

PLATO/WICAT Systems Company

8800 Queen Avenue South

Minneapolis, MN 55431

(800) 451-5266

(612) 921-6300

Former Names:

WICAT

Systems Software:

Authoring system, word processing, FORTRAN, Pascal

Instructional Components:

Reading:

K--8 (Reading, Reading Comprehension)

Language Arts:

K--6 (Writing)

Grades 3--12 (Language Arts)

Grades 2--6 (Spelling)

Grades 3--6 (Sentence Combining)

Grades K--6 (English as a Second Language)

Other:

Mathematics: Grades K--Adult

Computer Literacy:

Programming:

Typing: Grades K--12

French

Hardware:

Central Operation: Minicomputer

Workstations: System 300 workstations, or Apple II-series or IBM-PC.

Other: Voice synthesis with student headphones

PLATO/WICAT

Local Plato Delivery System (LPDS)

Publisher:

PLATO/WICAT Systems Company

8800 Queen Avenue South

Minneapolis, MN 55431

(800) 451-5266

(612) 921-6300

Former Names:

PLATO

Systems Software:

Word processing, authoring system, FORTRAN, Pascal

Instructional Components:

Remediation Package (High School)

Basic Skills (3rd-8th grade level reading and mathematics)

High School Skills (GED Preparation)

Life Coping Skills

Advanced Placement Package (College-Bound High School)

Physics, Chemistry, Pre-calculus, Calculus, Algebra, FORTRAN, Pascal

Hardware:

Central Operation: IBM-PC/AT-compatible file server

Workstations: IBM-PC-compatible, capable of running diskette-based software independently.

Other: Touch-sensitive monitor screens,

Houghton Mifflin

Dolphin Curricula

Publisher:

Houghton Mifflin Company
Educational Software Division
P.O. Box 683
Hanover, NH 03755
(603) 448-3838

Former Names: Time Share Corporation, Time Share/A Houghton Mifflin Company, TSC/A Houghton Mifflin Company, Houghton Mifflin TSC Division, Individualized Pupil Monitoring System (IPMS), Skills Teaching for Reading Improvement, Development and Evaluation (STRIDE)

Systems Software:

Instructional Components:

Reading: Grades 3--8

Language Arts: Grades 3--8

Other:

Mathematics: Grades 1--8

Computer Literacy:

Programming:

Guidance: Guidance Information System (data base of occupations, colleges, financial aid sources)

Hardware:

Central Operation: Minicomputer

Workstations: Hewlett-Packard terminals

Other:

TOAM Computer Aided Instruction System

DEGEM Systems

Publisher:

DEGEM - SOLCOOR

Two Park Avenue

New York, NY 10016-5635

212-561-7200, 212-561-7250

Former Names:

Systems Software:

BASIC, FORTRAN, LOGO, Pascal, authoring systems, word processor, school scheduling

Instructional Components:

Reading: Grades 2-7 Reading Comprehension

Language Arts:

English as a Second Language

Other:

Mathematics: Grades 1-9 arithmetic, Grades 1-7 Geometry, Algebra

Computer Literacy:

Programming:

Science: Physics, Electricity

Other: Typing, Accounting

Hardware:

Central Operation: Minicomputer

Workstations: Terminal consists of screen with 20 touch-keys for numbers and arithmetic operators. If programming or English instruction is desired, an add-on full keyboard can be ordered.

Other: